"low battery 2" since the last time this minimum was reset (the maximum displayable value is 9999). In the case where "low battery 2" has never been reached, "- - - -" appears in the VTBI display.

AUDIO TEST

1. Press COMPUTER CONTROL/MONITOR repeatedly until:
   - "Audio Test" scrolls on the Operator Information display.
2. Press START and check:
   - "no audio", "key", "variable", and "max" appear in the Operator Information display.
   - associated feedback voltages appear in the VTBI display.
   - an audible tone is sounded that increases in intensity as each message appears in the Operator Information display.

POWERDOWN TEST

1. Press COMPUTER CONTROL/ MONITOR repeatedly until:
   - "Powerdown Test" scrolls on the Operator Information display.
2. Press START and check:
   - "OFF n" displays statically on the Operator Information display ('n' counts down in seconds from 3 to 1)
   - After reaching 1 the instrument shuts down.

MECHANISM ALARM CIRCUIT (M.A.C.)

Gemini PC-1 instruments are being manufactured with a pump mechanism alarm circuit (M.A.C.) to enhance detection of impact damage to the instrument as the result of dropping or other abnormal handling.

If a PC-1 pump/controller goes into an alarm condition and scrolls "HELP INTERNAL ERROR" following Power On, check the Error Code on the Central Display. These alarm conditions are associated with either faulty AIL hardware or a disconnect in the pump mechanism alarm circuit. To determine the specific problem, perform the following troubleshooting procedures.

a. Turn off the instrument and remove the AC power cord from the AC outlet.

b. Separate the case (refer to Section 5.5.1).
   - Use a 5/32" Allen driver or wrench to remove the four socket head screws that connect the front and rear case assemblies. (Do not leave screws on work surface. Front panel could be damaged if front case is laid on the screws).

NOTE

When separating and positioning the front and rear cases for M.A.C. installation, ensure that no tension is applied to the harnesses connecting the case assemblies.

c. Inspect the upper and lower M.A.C. assembly contacts on each pump mechanism for a disconnected condition.

d. If the M.A.C. contacts (spring clips) are in place, inspect the M.A.C. wires and connectors for a cut or break.

e. If the M.A.C. circuit is intact, then the alarm condition can be attributed to an AIL hardware problem. Follow maintenance manual procedures for troubleshooting, removal and replacement of the AIL/SCD assembly.

f. If the M.A.C. contacts are disconnected, the instrument has been subjected to an abnormal impact condition. Visually inspect the pump mechanism(s) for severe cracks or breaks in the areas around the mounting flanges and housing pivot points. Small cracks do not affect functionality.

g. If no visual damage is detected, attempt to move the top of the pump mechanism laterally (side to side). If the mechanism is intact, there will be very little, if any, lateral motion. If the mechanism is broken, the lateral movement will be easily discernible.

NOTE

Do not mistake movement of the top of the pump mechanism along the hinge axis as

lateral movement.

h. If the mechanism is intact, with no severe cracks or breaks, inspect the M.A.C. components for obvious damage; e.g., severely bent copper components. If all components are intact and undamaged, reconnect the upper and lower M.A.C. spring clips.

NOTE

It is important that the M.A.C. spring clips be compressed only the amount necessary to allow the contacts to be inserted into the slots on the top plate.

i. If a mechanism is severely cracked or broken, or if the M.A.C. system is damaged, replace the damaged components.

5.4 TROUBLESHOOTING

The troubleshooting routines presented in the Table 5-1 are correlated directly to the Maintenance Mode test sequence described in Section 5.3. The recommended troubleshooting procedure is to perform the Maintenance Mode test that replicates the reported discrepancy; e.g., if a control key is not functioning - run the Keypad test, if a LED segment is out - run the Lamp test, if the instrument fails to power-up - check the probable causes under Initialization.

The corrective actions are listed in a descending order of failure probability. Performing the corrective actions in the sequence provided should reduce repair time and expedite returning the instrument to patient care service. If the test equipment required to troubleshoot and repair a microprocessor system is not available at your facility, it is recommended the instrument be returned to the factory for repair.

Table 5-1. Troubleshooting/Fault Isolation Guide

Test/Fault	Probable Cause	Corrective Action
INITIALIZATION		
LEDs fail to illuminate	Battery <5.3 Volts	Connect AC Power
	Blown Fuse (Input Module)	Replace fuse
	F1 on Power Supply PCB blown POWER ON switch inoperative	Replace fuse Check Keypad Cable Connector
		Test/Replace Keypad
	NICAD Battery Failure	Replace NICAD Battery
	Digital Logic Failure	Replace Digital Logic Board
No Alarm tone	Audio Oscillator Failure	Replace Audio Oscillator
LEDs stay ON	Digital Logic Failure	Replace Digital Logic Board
VERSION DISPLAY		
'maintenance Vx.xx vice 'PC-1 Vx.xx'	Initialized in Maintenance Mode	Reinitialize in Normal Mode
'PC-1 Vx.xx' vice 'maintenance Vx.xx'	COMPUTER CONTROL/ MONITOR switch not held during initialization	Reinitialize - hold COMPUTER CONTROL/MONITOR switch during initialization

	COMPUTER CONTROL/ MONITOR switch failure	Replace Keypad
Model/Version fails to scroll	Digital Logic Failure Display Board Failure Power Supply Board Failure	Replace Digital Logic Board Replace Display Board Replace Power Supply Board
Model/Version display corrupted	Digital Logic Failure	Replace Digital Logic Board
	Display Board Failure	Replace Display Board
LAMP TEST w/AUDIO		
LED segment fails to illuminate	Display Board Failure Digital Logic Failure	Replace Display Board Replace Digital Logic Board
No Audio adjust	Audio Control Pot. Failure	Replace Audio Control Pot.
KEYPAD TEST		
Key/Display Mismatch or Invalid Key	Keypad Failure	Replace Keypad Assembly
	Display Board Failure	Replace Display Board
ERROR LOG DISPLAY	(See Table 5-2, 2a or 2b for a listing and description of Error Log Codes)	
MOTOR HOMING TEST		
Motor Fails to Home to selected position ±1 step	Motor Harness Disconnected	Reconnect Motor Harness
	Digital Logic Failure	Replace Digital Logic Board
	Motion Sensor Harness Disconnected	Reconnect Motion Sensor Harness
	Motion Sensor Failure	Replace Motion Sensor
PUMP TEST (Allows pumping mechanism to be operated without Alarm stoppage)		
SERIAL PORT TEST		
"echo" test fail	Faulty Communication Plug	Replace Comm Emulator Plug
	Digital Logic Board Failure	Replace Digital Logic Board
	Power Supply Board Failure	Replace Power Supply Board
A/D VOLTAGE DISPLAY		
"strain" reading >'0', set not installed	Strain Beam Out of Calibration	Recalibrate Strain Beam (see Section 5.7)
	Strain Beam Failure	Replace Strain Beam
	Digital Logic Board Failure	Replace Digital Logic Board

"strain" reading <'100' or >'200' with dry pumping segment installed	Strain Beam Out of Calibration	Recalibrate Strain Beam
	Strain Beam Failure	Replace Strain Beam
	Digital Logic Board Failure	Replace Digital Logic Board
"sys batt" reading <'279' or >'355'	Power Supply Board Failure	Check Battery Voltage at in-line fuse
		Replace Power Supply Board
	Digital Logic Board Failure	Replace Digital Logic Board
	Battery Failure	Replace Battery
	Wrong Battery Installed	Install IPB Listed Battery
"V(mains) reading <'245' or >'255' (AC connected)	Power Supply Board Failure	Replace Power Supply Board
	Digital Logic Board Failure	Replace Digital Logic Board
"V(ref)" other than '249'±05%	Power Supply Board Failure	Replace Power Supply Board
	Digital Logic Board Failure	Replace Digital Logic Board
"V(audio)" *normally 0*	N/A	
"V(NVRAM)" reading <'246' or >'328'	NiCad Battery Failure	Recharge NiCad Battery
		Replace NiCad Battery
	Digital Logic Board Failure	Replace Digital Logic Board
	Power Supply Board Failure	Replace Power Supply Board
INPUT PORT TEST		
'Normal' mode	See Section 5.3.2 Maintenance Mode Operation - Input Port Test for expected readout in Normal and Selftest modes. **NOTE** **The logic for the AIL and ECD sensors is reversed in relation to the other sensors (ECD sensors applicble to 110V only, except V8.12). Consequently, in the Normal mode test the AIL and ECD sensors are being tested for response to the processor strobe rather than sensor operation. The following AIL and ECD sensor operation tests indicate the response expected when conducting a test in the 'Selftest' mode.**	
AIL Sensor - wrong digit for condition	Ultrasonic Emitter/Receiver failure	Replace AIL/SCD Assembly
	Analog Circuit Failure	Replace AIL/SCD PC Board

	Digital Logic Board Failure	Replace Digital Logic Board
110V only (except V8.12). ECD Sensor - wrong digit for condition	Light Emitter/Receiver Failure	Replace ECD
	Communication Cable Failure	Reconnect or Replace Comm-ication Cable
	Power Supply Board Failure	Replace Power Supply Board
	Digital Logic Board Failure	Replace Digital Logic Board
SCD Sensor - wrong digit for condition	Light Emitter/Receiver Failure	Replace AIL/SCD Assembly
		Analog Circuit Failure Replace AIL/SCD PC Board
	Digital Logic Failure	Replace Digital Logic Board
Motion Sensor - wrong digit for condition	Sensor Failure	Replace Sensor
	Digital Logic Board Failure	Replace Digital Logic Board
Door Sensor - wrong Digit for condition	Sensor Failure	Replace Sensor
	Digital Logic Board Failure	Replace Digital Logic Board
	NOTE **In the 'Selftest' mode, the microprocessor is strobing the sensors in accordance with a software protocol. The digital presentation seen in the RATE and VTBI displays reflects the sensor response to the strobe. If the response is not the expected response, a problem exists within the strobe circuitry.**	
RAM Display	For IMED Engineering use only	
POWER DOWN TEST		
Displays remain On	Digital Logic Board Failure	Replace Digital Logic Board

Table 5-2. PC-1 Error Log Codes (V2.xx, V5.xx, V6.XX and V6.3x/4x)

The Error Codes listed below represent the results of software initiated subsystem tests. The tests are evaluated on Pass/Fail logic with an error code generated for a fail condition.

Code No.	Description	Meaning	Probable Cause
00	NOT USED		
01	Error Log	Occurs only during startup; the Error Log is reset resulting in loss of resident error log entries.	Logic Board Battery Circuit Check voltage at RAM VCC: If: <2.0V - NICAD battery failure
02	ROM	*Detected during power-up; instrument* fails CRC check and powers down immediately **WITHOUT** alarm.	*Logic Board*
03	NVRAM *Software Release V6.3x/4x*	Detected during power-up. The portion of RAM subjected to a CRC test fails. Failure results in loss of previously selected infusion parameters. Default parameters display. *Not Implemented*	Battery excessively discharged. Attempt recharge for 4 hours Logic Board Battery Circuit (see Error Code #1)
04	RAM	*During power-up a destructive RAM test is* performed on RAM segments not related to infusion parameters. Instrument fails this validity check and powers down **WITHOUT** alarm.	Logic Board
05	Critical parameters out of range **Software Release V6.xx** *Software Release V6.3x/4x*	During power-up a range check is performed on infusion parameters stored in NVRAM. Failure of this check results in loss of previously selected infusion parameters. Default parameters are displayed. If a variable is out of range the following occurs: a transparent 9x error code is logged, "HELP INTERNAL ERROR" scrolls, an audio alarm sounds, NVRAM values revert to default, all keys except PAUSE/STOP are disabled. *Not Implemented*	Logic Board Battery Circuit (see Error Code #1)

06	Battery	During power-up voltage is checked; measurements >8.0 or <≈5.7 VDC cause the instrument to immediately power down **WITHOUT** Alarm.	Battery excessively discharged. Attempt recharge for 4 hours Battery Circuit (see Error Code #1) Logic Board
07	A/D	Occurs during power-up battery check or any subsequent A/D conversion. An A to D interrupt is programmed upon completion of A/D readings. Failure to detect this interrupt within a pre-determined time frame will cause the instrument to lock up and display the error code in the VTBI display.	Logic Board
08	Invalid Key	Occurs when a keycode is received that is outside of the legal keycode range. An error is logged, "HELP INTERNAL ERROR" scrolls, audio alarm sounds, pumping stops, all keys except PAUSE/STOP are disabled and error code is displayed in VTBI.	Display Board Logic Board
09-11	NOT USED		
12	Software Release V2.xx General Software Error *Software Release V5.xx* *NOT USED* **Software Release V6.xx and V6.3x/4x** **General Software Error**	Occurs when a runaway program is detected during a routine check of software logic. "HELP INTERNAL ERROR" scrolls, the Error Code is displayed in the VTBI, audio alarm sounds and all keys except PAUSE/STOP are disabled.	Logic Board
13	Motor Sync Off	Occurs when an error >1.5% in a sample of 50 motor revolutions is detected by the motion sensor. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code is displayed in VTBI and all keys except PAUSE/STOP are disabled.	Pumping Mechanism
14	NOT USED		

15	No Sync Flag detected	Occurs 120 motor steps after the motion sensor fails to confirm motor sync. The motion sensor is inoperative or the motor is not turning. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board Pumping Mechanism
16-17	NOT USED		
18	*Software Release V6.3x/4x* *Fast Battery Discharge*	*After ≥10 hours of continuous operation on AC power, instrument must operate for ≥2.5 hours on battery; if unable, a fast battery discharge condition occurs: "HELP BATTERY" scrolls, audio alarm sounds, error codes 18 and 38 are logged, error code 38 displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled.*	*Battery Capacity Diminished* *Battery Charger Circuitry* *Power Supply Board*
19	*Software Release V6.3x/4x* *Improper Power-Down*	*Occurs when the instrument is powered-down without using the PAUSE/STOP control (i.e. Watchdog or battery failure). During the next power-up, the instrument will enter an Internal Error condition: "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code is logged and displayed in VTBI and all keys except PAUSE/STOP are disabled.*	*Normal power-down sequence must be activated to reset instrument.*
20	Door Alarm	Occurs when the microprocessor detects a failure of the door sensor. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board Door Harness Assembly
21	NOT USED		
22	AIL Alarm	Occurs when the microprocessor detects a failure of the AIL sensor. "HELP INTERNAL ERROR" scrollS, audio alarm sounds, error code displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	AIL Board AIL/Door Harness Logic Board
23-25	NOT USED		

26	Battery Overcharge	Occurs when battery voltage >8.0 VDC is detected during normal instrument operation. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Power Supply Board
27	NOT USED		
28	ROM CRC	Occurs when a failure of the CRC check of ROM is detected during normal instrument operation. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board
29	Software Release V2.xx Insanity *Software Release V5.xx* *NOT USED* **Software Release V6.xx and V6.3x/4x** **NOT USED**	Occurs when a range check of RAM infusion parameters detects an out-of-range condition. "HELP INTERNAL ERROR" scrolls and the Error Code No. appears in the VTBI display.	Logic Board
30-34	NOT USED		
35	V Ref **Software Release V6.xx and V6.3x/4x**	Occurs when the main processor, through an A/D channel, is unable to read a 2.5V reference within ±5%. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled. **Tolerence for reading 2.5V reference is ±12%**	Logic Board
36	Audio	Occurs when the main processor fails to detect at least 0.2V on an A/D channel following audio circuitry activation. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping continues and all keys except PAUSE/STOP are disabled.	Logic Board
37	NOT USED		

38	Low Battery II Error	Occurs when an A/D converter reads a battery voltage below ≈5.4V. "HELP BATTERY" scrolls, audio alarm sounds, pumping stops, error code displays on VTBI and all keys except PAUSE/STOP are disabled.	Battery excessively discharged. Attempt recharge for 4 hours Lead Acid Battery Power Supply Board
39	NOT USED		
40	*Software Release V6.3x/4x* *Error Log NVRAM Variables*	*Error Log partition of partitioned NVRAM experienced a CRC failure between power-down and power-up. Variables in effected partition are initialized to default values and error code is logged. Instrument is usable.*	*Improper Power-down* *NVRAM Battery* *Logic Board*
41	*Software Release V6.3x/4x* *Fixed Biotech Setup NVRAM Variables*	*Fixed Biotech Setup partition of partitioned NVRAM experienced a CRC failure between power-down and power-up. Variables in effected partition are initialized to default values and error code is logged. Instrument is usable.*	*Improper Power-down* *NVRAM Battery* *Logic Board*
42	*Software Release V6.3x/4x* *Non-Critical State NVRAM Variables*	*Non-Critical State partition of partitioned NVRAM experienced a CRC failure between power-down and power-up. Variables in effected partition are initialized to default values and error code is logged. Instrument is usable.*	*Improper Power-down* *NVRAM Battery* *Logic Board*
43	*Software Release V6.3x/4x* *Non-Critical Data NVRAM Variables*	*Non-Critical Data partition of partitioned NVRAM experienced a CRC failure between power-down and power-up. Variables in effected partition are initialized to default values and error code is logged. Instrument is usable.*	*Improper Power-down* *NVRAM Battery* *Logic Board*
44	*Software Release V6.3x/4x* *TPN Data NVRAM Variables*	*TPN Data partition of partitioned NVRAM experienced a CRC failure between power-down and power-up. Variables in effected partition are initialized to default values and error code is logged. Instrument is usable.*	*Improper Power-down* *NVRAM Battery* *Logic Board*
45	*Software Release V6.3x/4x* *Critical State NVRAM Variables*	*Critical State partition of partitioned NVRAM experienced a Validity check failure between power-down and power-up. Effected variables in effected partition are initialized to default values and error code is logged. Instrument is usable.*	*Improper Power-down* *NVRAM Battery* *Logic Board*

46	*Software Release V6.3x/4x* *Critical Data NVRAM Variables*	*Critical Data partition of partitioned NVRAM experienced a Validity check failure between power-down and power-up. Effected variables in effected partition are initialized to default values and error code is logged. Instrument is usable.*	*Improper Power-down* *NVRAM Battery* *Logic Board*
47-58	NOT USED		
59	**Software Release V6.xx and V6.3x/4x** **IPC Synchronization**	**Unacceptable level of inter-processor communication failures. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.**	Logic Board Display Board
60	NOT USED		
61	Software Releases V2.xx/V5.xx Three bad messages (IPC) **Software Release V6.xx and V6.3x/4x** **NOT USED**	This error code is related only to software diagnostics.	Not hardware related, no action required
62	**Software Release V6.xx and V6.3x/4x** **Power-up Audio**	**During power-up A/D converter checks audio transducer input voltage to be >0.2VDC during audio activity. If not "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.**	Logic Board
63	NOT USED		
64	NVRAM Battery	NVRAM battery voltage is <2.4 VDC for a specified period, then: "HELP BATTERY" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board
65	**Software Release V6.xx and V6.3x/4x** **EPROM/Software Version Mismatch**	**At power-up logic board processor checks version number of display processor software. If a mismatch: "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.**	Wrong Display EPROM Wrong Logic EPROM

66	Slave data error	Critical values (rate, VTBI and/or language) in display processor are checked for legal range. If out: "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	1st occurance, recycle and ignore Logic Board Display Board
67	Slave segment error	Display processor detects an unacceptable voltage level on a 7 segement display. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Display Board
68	NOT USED		
69	Slave RAM error	Display processor startup RAM test has failed. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Display Board
70	Slave IPC CRC error	Display processor has received three IPC messages in a row from the 8096 containing a bad CRC. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Error is possible under normal conditions, but should not be common. If repeated occurance: Logic Board Display Board
71	Strain beam error	Occurs when the main processor does not detect ≥100 mV variance between the highest and lowest readings during 2 revolutions of pumping mechanism. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Strain Beam Logic Board
72	Motor revolution error	Actual time required to complete a pumping mechanism revolution differs from calculated value by ±12% for 3 revolution sample. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Sticking pumping mechanism Logic Board

73	Rate corruption error	Value used to calculate motor tables does not = redundancy check value. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board
74	Motor table calculation error	Value of calculation error on motor table >200msec. Implies a processor failure. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board
75	Stuck bits error	Runtime working RAM failure, 8096 side. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board
76-79	NOT USED		

The following startup and runtime errors result from NVRAM insanity. In software release V2.xx/V5.xx/V6.xx instruments the error codes will appear in the error log; however, the codes will be lost if the NVRAM purges itself following an insanity condition. In software release V6.3x/4x instruments the insanity error code will be retained. In the event one of these errors is displayed: check NVRAM battery voltage after charging battery for ≥8 hours; if low, replace battery; if within limits, replace Logic Board.

Power-up / Runtime	Meaning
80 / 90	NOT USED
81 / 91	Current rate out of range
82 / 92	Piggyback rate out of range
83 / 93	Current VTBI out of range
84 / 94	Piggyback VTBI out of range
85 / 95	Total Volume Infused out of range
86 / 96	Secondary Volume Infused out of range
87 / 97	Motor step number out of range
88 / 98	RAM copy of ROM-CRC is in error
89 / 99	Error in Rate, VTBI, etc. for fractional mode

Table 5-2a. PC-1 Error Log Codes (V7.xx)

The Error Codes listed below represent the results of software initiated subsystem tests. The tests are evaluated on Pass/Fail logic with an error code generated for a fail condition.

Code No.	Description	Meaning	Probable Cause
00	NOT USED		
01	*Error Log*	*Occurs only during startup; the Error Log is* reset resulting in loss of resident error log entries.	*Logic Board* Battery Circuit Check voltage at RAM VCC after charging battery for ≥8 hours: If: <2.0V - NICAD battery failure
02	RESERVED FOR PC-1 6.XX		
03	RESERVED FOR PC-1 INTEGER		
04	RAM	During power-up a destructive RAM test is performed on RAM segments not related to infusion parameters. Instrument fails this validity check and powers down **WITHOUT** alarm.	Logic Board
05	RESERVED FOR PC-1 INTEGER		
06	Battery	During power-up voltage is checked; measurements >8.0 or <5.15 VDC cause the instrument to immediately power down **WITHOUT** alarm.	Battery excessively discharged. Attempt recharge for 4 hours. Battery Circuit (see Error Code #1) Logic Board
07	A/D	Occurs during power-up battery check or any subsequent A/D conversion. An A to D interrupt is programmed upon completion of A/D readings. Failure to detect this interrupt within a pre-determined time frame will cause the instrument to lock up and display the error code in the VTBI display.	Logic Board

08	Invalid Key	Occurs when a keycode is received that is outside of the legal keycode range. An error is logged, "HELP INTERNAL ERROR" scrolls, audio alarm sounds, pumping stops, all keys except PAUSE/STOP are disabled and error code is displayed in VTBI.	Display Board Logic Board
09-12	ROM Bank [0, 1, 2, 3] - Checksum	During power-up, a checksum value is calculated for the four ROM banks. If the value does not match a precalculated "correct" value, a corruption of ROM is suspected, and the instrument is shut down **WITHOUT** alarm.	Logic Board
13	Motor Sync Off	Occurs when an error >1.5% in a sample of 50 motor revolutions is detected by the motion sensor. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code is displayed in VTBI and all keys except PAUSE/STOP are disabled.	Pumping Mechanism Logic Board Power Supply Board
14	RESERVED FOR PC-2 TITRATION		
15	No Sync Flag detected	Occurs 120 motor steps after the motion sensor fails to confirm motor sync. The motion sensor is inoperative or the motor is not turning. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board Power Supply Board Pumping Mechanism
16	RESERVED FOR PC-2 TITRATION		
17	RESERVED FOR PC-2 INTEGER		
18	Fast Battery Discharge	After ≥1 hour of continuous operation on AC power, instrument must operate for >1/2 the charged time on battery; if unable, a fast battery discharge condition occurs: "HELP BATTERY" scrolls, audio alarm sounds, error codes 18 and 38 are logged, error code 38 displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Battery Capacity Diminished Battery Charger Circuitry Power Supply Board

19	Improper Power-Down	Occurs when the instrument is powered-down without using the PAUSE/STOP control (i.e. Watchdog or battery failure). During the next power-up, the instrument will enter an Internal Error condition: "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code is logged and displayed in VTBI and all keys except PAUSE/STOP are disabled.	Normal power-down sequence must be activated to reset instrument. Logic Board Power Supply Board Battery
20	Door Alarm	Occurs when the microprocessor detects a failure of the door sensor. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board Door Harness Assembly
21	RESERVED FOR PC-2 TITRATION		
22	AIL Alarm	Occurs when the microprocessor detects a failure of the AIL sensor. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	AIL Board AIL/Door Harness Logic Board
23	RESERVED FOR PC-2 TITRATION		
24-25	Inverse Flag Errors	During power-up or runtime, important variables are checked against their inverse copies to verify that no RAM bit corruption has taken place. If any of the inverse flags are incorrect, 'HELP INTERNAL ERROR" scrolls, "24" or "25" is displayed in VTBI, "0" in RATE, audio alarm sounds, and all keys except PAUSE/STOP are disabled.	Logic Board
26	Battery Overcharge	Occurs when battery voltage >8.0 VDC is detected during normal instrument operation. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Power Supply Board
27	RESERVED FOR PC-2 TITRATION		

28	Illegal ROM Access Failure	All unused ROM is protected from execution through illegal ROM space. If there is an illegal ROM access failure, the instrument logs the error code and enters a watchdog condition.	Logic Board
29	Short LB1 to LB2 Time	After a minimum charge time, the instrument moves from Low Battery Level 1 to Low Battery Level 2 within 15 minutes, error code 29 is logged, and the instrument enters a Low Batt II condition (see Error Code 38).	Battery Capacity diminished Battery Charger circuitry Power Supply board
30	RESERVED FOR PC-2 TITRATION		
31-32	RESERVED FOR PC-2 INTEGER		
33	ROM Stack Push Error	During ROM Bank switching, a ROM stack stores the history of which ROM to return to. If this stack overflows, or the integrity is corrupted, Error Code 33 is logged and the instrument enters a watchdog condition.	Logic Board
34	ROM Stack Pop Error	During ROM Bank switching, a ROM stack stores the history of which ROM to return to. If this stack is empty or the integrity is corrupted, Error Code 34 is logged and the instrument enters a watchdog condition.	Logic Board
35	V Ref	Occurs when the main processor, through an A/D channel, is unable to read a 2.5V reference within ±12%. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays in VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board
36	Audio	Occurs when the main processor fails to detect at least 0.2V on an A/D channel following audio circuitry activation. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping continues and all keys except PAUSE/STOP are disabled.	Logic Board
37	RESERVED FOR PC-2 TITRATION		

38	Low Battery II Error	Occurs when an A/D converter reads a battery voltage below ≈5.15V. "HELP BATTERY" scrolls, audio alarm sounds, pumping stops, error code displays on VTBI and all keys except PAUSE/STOP are disabled.	Battery excessively discharged. Attempt recharge for 4 hours Lead Acid Battery Power Supply Board
39	General Software Error	Occurs when the normal calling sequence in the main software loop becomes corrupted, or a case statement index is corrupted. The error code is logged "HELP INTERNAL ERROR" scrolls, "39" displays in VTBI and "0" in RATE, audio alarm sounds, the instrument stops pumping, and all keys except PAUSE/STOP are disabled.	Logic Board
40-47	Partition Specific NVRAM failure	The non-volatile Random Access Memory (NVRAM) is divided into seven partitions, each of which has a validity check performed on it at power-up. If this check fails, a corruption of NVRAM is suspected. The code is logged, all variables in the affected NVRAM partition are initialized to default values, and the instrument is ready for normal use. The codes associated with each partition of NVRAM variables are: 40 Error Log 41 Fixed Biotech Setup 42 Non-critical State 43 Non-critical Data 44 VersaTaper 45 Critical State 46 Critical Data 47 AutoTaper	Logic Board
48-49	RESERVED FOR PC-2 TITRATION		

50-52	ROM Bank [1,2,3] Reset Error	When the logic processor is reset, ROM bank 0 should be the first bank accessed; if bank 1, 2, or 3 is accessed first, a ROM bank reset error has occurred and the error code is logged, "ROMx rst" will display, the audio alarm is sounded, and the instrument enters a watchdog state.	Logic Board
53	NOT USED		
54	Controller State Error	If the controller state is found to be out of range, the error code is logged, "HELP INTERNAL ERROR" displays, "54" displays in VTBI and "0" in RATE, the audio alarm is sounded, the instrument stops pumping, and all keys except the PAUSE/STOP are disabled.	Logic Board
55	NiCad Circuit failure	The NiCad circuitry is periodically validated; if a circuit failure condition is sensed, the error code is logged, "HELP INTERNAL ERROR" displays, "55" shows in VTBI and "0" in RATE, the audio alarm is sounded, the instrument stops pumping, and all keys are disabled except the PAUSE/STOP key.	Logic Board NiCad Battery
56	Event History NVRAM failure	The Event History NVRAM partition has a Cyclic Redundancy Code (CRC) calculation or a validity check performed on it at power-up. If a CRC result does not match the previous result, or the validity check fails, a corruption of NVRAM is suspected. The code is logged, all variables in the affected NVRAM partition are initialized to default values, and the instrument is ready for normal use.	Logic Board
57	Dual Charger Error	The Dual Charger timer variable is periodically range-checked; if out-of-range, the error code is logged. No audible alarm.	Power Supply Board Battery

58	Audio Channel Error	Audio software is common to both PC-1 and PC-2 (2 channel). If the PC-1 attempts to access the non-existent Channel B (existent only in the PC-2), the error code is logged, "HELP INTERNAL ERROR" displays, "58" shows in VTBI and "0" in RATE, audio alarm is sounded, the instrument stops pumping, and all keys are disabled except PAUSE/STOP. The instrument **may** enter a watchdog condition.	Logic Board
59	IPC State Error	Unacceptable level of inter-processor communication failures. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board Display Board
60	IPC Message Error	If the logic processor determines that the display processor has been silent for 2 seconds, or if a number of IPC errors have been accumulated, the error code is logged, "HELP INTERNAL ERROR" displays, "60" shows in the VTBI, audio alarm is sounded, the instrument stops pumping, and all keys are disabled except PAUSE/STOP.	Logic Board Display Board
61	Illegal Error Code	The variable which indicates which error type has occurred is range checked before the error is logged. If the error value is found to be out of range, the value is forced to the illegal error code value. The error code is logged, "HELP INTERNAL ERROR" displays, "61" shows in the VTBI, audio alarm is sounded, the instrument stops pumping, and all keys are disabled except PAUSE/STOP.	Logic Board
62	Power-up Audio	During power-up A/D converter expects audio transducer input voltage to be >0.2VDC during audio activity. If not, "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board

63	Illegal ROM Bank Request	The ROM bank ID number of the intended destination ROM bank is not legal. The error code is logged and the instrument enters a watchdog condition.	Logic Board
64	NVRAM Battery	NVRAM battery voltage is <2.4 VDC for a specified period, then: "HELP BATTERY" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board NiCad Battery
65	EPROM/Software Version Mismatch	At power-up logic board processor checks version number of display processor software. If a mismatch: "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Wrong Display EPROM Wrong Logic EPROM
66	Slave data error	Critical values (rate, VTBI and/or language) in display processor are checked for legal range. If out of range: "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	1st occurance, recycle and ignore Logic Board Display Board
67	Slave segment error	Display processor detects an unacceptable voltage level on a 7 segment display. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Display Board
68	TPN Time Inverse Error	The TPN timekeeping variables are safety checked against inverted duplicate copies. If there is a mismatch, the error code is logged, "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board
69	Slave RAM error	Display processor startup RAM test has failed. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Display Board

70	Slave IPC CRC error	Display processor has received three IPC messages in a row from the 8096 containing a bad CRC. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	If repeated occurance: Logic Board Display Board
71	Strain beam error	Occurs when the main processor does not detect ≥100 mV variance between the highest and lowest readings during any 2 revolutions of pumping mechanism. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Strain Beam Logic Board
72	Motor revolution error	Actual time required to complete a pumping mechanism revolution differs from calculated value by ±12% for 3 revolution sample. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Sticking pumping mechanism Logic Board
73	Rate corruption error	Value used to calculate motor tables does not equal redundancy check value. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board
74	Motor table calculation error	Value of calculation error on motor table >200msec. Implies a processor failure. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board
75	Stuck bits error	Runtime working RAM failure, 8096 side. "HELP INTERNAL ERROR" scrolls, audio alarm sounds, error code displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board

76	Motor Speed (divide by 0) Error	The motor speed variable is range-checked to prevent divide-by-zero errors. If detected, the error code is logged, "HELP INTERNAL ERROR" scrolls, audio alarm sounds, "76" displays on VTBI, pumping stops and all keys except PAUSE/STOP are disabled.	Logic Board
77	Insane power-down Error	The power-down software checks to make sure that an orderly sequence of events has occurred. If not, then the error code is logged, the audio alarm sounds, and the instrument enters a watchdog condition.	Logic Board
78-79	NOT USED		
80-89, 90-99	Detailed Insanity Errors	The following startup and runtime errors result from NVRAM insanity. The specific error code is logged, "HELP INTERNAL ERROR" displays, code displays in VTBI, audio alarm is sounded, all keys are disabled except the PAUSE/STOP key. Pwr-up / Runtime / Meaning 80 / 90 / VersaTaper data error 81 / 91 / Current rate out of range 82 / 92 / Piggyback rate out of range 83 / 93 / Current VTBI out of range 84 / 94 / Piggyback VTBI out of range 85 / 95 / Tot Vol Infused out of range 86 / 96 / Sec Vol Inf out of range 87 / 97 / Motor step number out of range 88 / 98 / NOT USED 89 / 99 / Error in Rate, VTBI, etc. for MICRO mode	In the event one of these errors is displayed: check NVRAM battery voltage after charging battery for ≥8 hours; if low, replace battery; if within limits, replace Logic Board.
100-103	ROM Bank [0, 1, 2, 3] CRC Failure	If the runtime CRC does not match a "correct" CRC stored value , a corruption of ROM is suspected, and the specific error code is logged, "HELP INTERNAL ERROR" displays, code displays in VTBI, audio alarm is sounded, instrument stops pumping, all keys are disabled except the PAUSE/STOP key.	Logic Board

104-106	AutoTaper Data Insanity Errors	Important AutoTaper values are checked to see that they are within their legal ranges. If not, the following error codes indicate which data is corrupted, and the specific error code is logged, "HELP INTERNAL ERROR" displays, the code displays in VTBI, audio alarm is sounded, all keys are disabled except the PAUSE/STOP key.	Logic Board
107-110	AutoTaper Context Errors	Important AutoTaper contexts are checked to see that they are within defined contexts. If not, the following error codes indicate which context is in error, and the specific error code is logged, "HELP INTERNAL ERROR" displays, the code displays in VTBI, audio alarm is sounded, all keys are disabled except the PAUSE/STOP key.	Logic Board
111-118	NOT USED		
119	Display Numbers Error	The RATE and VTBI displays are checked for reasonable values. If checks reveal invalid *data, the code is logged,* "HELP INTERNAL ERROR" displays, "119" displays in VTBI, audio alarm is sounded, the instrument stops pumping, and all keys are disabled except the PAUSE/STOP key.	Logic Board
120-123	Illegal ROM Bank [0, 1, 2, 3] Procedure Call	When ROM bank switching is in progress, the procedure is checked and validated. If *out-of-range, the specific error code is logged* and the instrument enters a watchdog condition.	Logic Board
124-125	NOT USED		
126-129	Failed to Reach ROM Bank [0, 1, 2, 3]	The ROM bank ID number of the intended destination ROM bank does not match; the specific error code is logged and the instrument enters a watchdog condition.	Logic Board
130-255	NOT USED		

Table 5-2b. PC-1 Error Log Codes (V8.xx)

The Error Codes listed below represent the results of sub-system tests initiated by software. The tests are evaluated using Pass/Fail logic with an error code generated for a fail condition.

Unless otherwise indicated, all error codes result in malfunction I/O, i.e., (1) the appropriate error code is recorded in the error log, (2) "HELP INTERNAL ERROR" is scrolled, (3) audio alarm is generated, (4) pumping is stopped, (5) all keys except PAUSE/STOP are disabled, and (6) '0' and the error code are displayed in the rate and VTBI LEDs, respectively. A malfunction condition is terminated by powering the instrument down using the PAUSE/STOP key.

Code No.	Description	Meaning	Probable Cause
00	NOT USED		
01	Error Log Reset	Marks a clearing of the error log. Initialization occurs (1) at the time of instrument manufacture and (2) when corruption of the error log is detected (typically due to a low battery condition). This error does not result in alarm I/O.	Logic Board Battery Circuit (Check voltage at RAM VCC after charging battery for at least 8 hours: if less than 2V, a NICAD battery failure is indicated)
02-05	NOT USED		
06	Battery Failure	Occurs when power-up testing of the system battery reveals voltages greater than 8 VDC or less than 5.15 VDC; causes the instrument to immediately power down without alarm.	Battery excessively discharged. Attempt recharge for 4 hours. Battery Circuit Logic Board
07	A/D Failure	Marks the failure of an expected A/D end-of-conversion interrupt to occur.	Logic Board
08	Invalid Key	Marks insanity in the Logic Processor's working image of the most recent key-press data.	Logic Board
09-12	Startup ROM CRC failures	Marks the failure of the CRC signature calculated over Logic Processor software to match that stored in ROM; causes the instrument to shut down without alarm.	Logic Board
13	Motor Sync Error	Occurs when an error exceeding 1.5% in a sample of 50 motor revolutions is detected by the motion sensor.	Pumping Mechanism Logic Board Power Supply Board

14	NOT USED		
15	Sync Flag Failure	Flagged when the motion sensor fails to confirm expected motor activity (because either the motion sensor is non-functional or the motor is not turning).	Logic Board Power Supply Board Pumping Mechanism
16-17	NOT USED		
18	Fast Battery Discharge	Marks a battery that is unable to hold a charge. After at least 1 hour of continuous operation on AC power, the instrument is required to be able to operate on battery for greater than one half the charge time; if unable to do so, error 18 is flagged: "HELP BATTERY" scrolls, audio alarm sounds, error codes 18 and 38 are logged, error code 38 is displayed in the VTBI LEDs, pumping stops, and all keys except PAUSE/STOP are disabled.	Battery Capacity Diminished Battery Charger Circuitry Power Supply Board
19	Abnormal Power-Down	Occurs following a scenario where the instrument is powered down or reset without using the PAUSE/ STOP key (i.e., following watchdog or battery failure).	Normal power-down sequence must occur to clear the condition. Logic Board Power Supply Board Battery
20	Door Circuitry Failure	Occurs when a failure of the door sensor circuitry is detected.	Logic Board Door Harness Assembly
21	NOT USED		
22	AIL Circuitry or M.A.C. Failure	Occurs when a failure of the AIL sensor is detected.	AIL Board M.A.C. AIL/Door Harness Logic Board
23	RESERVED FOR PC-1 TITRATION		
24	Startup Inverse Flag Errors	Marks the corruption of critical data expected to have been retained over power-down.	Logic Board

25	Run-time Inverse Flag Errors	Marks the corruption of data critical to run-time operation.	Logic Board
26	Battery Overcharge	Occurs when a system battery voltage in excess of 8 VDC is detected.	Power Supply Board
27-28	NOT USED		
29	Short LB1 to LB2 Time	Flagged if after a minimum charge time the instrument moves from Low Battery Level 1 to Low Battery Level 2 within 15 minutes; generates a Low Batt II (a.k.a. 'LB2') condition (see Error Code 38).	Battery Capacity diminished Battery Charger circuitry Power Supply Board
30-32	NOT USED		
33-34	Bank-switching Stack Errors	Marks stack overflow, underflow or stack pointer corruption in the stack used to control bank switching; generate watchdog conditions.	Logic Board
35	V Ref Error	Occurs when the reference voltage for the A/D converter is found to be outside the range of 2.5V+/-5%.	Logic Board
36	Audio Failure	Occurs when the main processor fails to detect at least 0.2V of audio activity following audio circuitry activation.	Logic Board
37	NOT USED		
38	Low Battery (LB2)	Occurs when less than ≈5.4V is read at the system battery; generates the following I/O: "HELP BATTERY" scrolls, audio alarm sounds, pumping stops, the VTBI LEDs display error 38, and all keys except PAUSE/STOP are disabled.	Battery excessively discharged. Attempt recharge for 4 hours Lead Acid Battery Power Supply Board
39	General Software Error	Marks a compound error condition with several contributing factors, all indicating that system software is not executing as programmed.	Logic Board
40-47	NVRAM Partition Failure	Marks corruption in the indicated NVRAM data partition. If the power-up validity check on any given partition fails, a partition-specific error code is logged and all data in the partition is re-initialized to default values. This error condition does not generate any alarm I/O.	Logic Board

		The partition mapping is as follows: 40 Error Log NVRAM 41 Biotech NVRAM 42 Non-critical State NVRAM 43 Non-critical Data NVRAM 44 Versa Taper NVRAM 45 Critical State NVRAM 46 Critical Data NVRAM 47 AutoTaper NVRAM	
48-49	NOT USED		
50-52	ROM Bank Reset Errors	Marks vectoring into a ROM bank other than 0 when the instrument is powered on; the error message 'ROMx rst' is displayed, where 'x' is one of 1, 2 or 3, to identify which bank was vectored into; the system goes into watchdog.	Logic Board
53	NOT USED		
54	Occlusion Detection Error	Occurs when the control variable critical to occlusion detection takes on an illegal value.	Logic Board
55	NiCad Circuit Failure	Occurs when the NiCad battery voltage is pulled abnormally low during controlled run-time load-testing.	Logic Board NiCad Battery
56	Event History Reset	Marks corruption in the Event History Log; the error code is logged and the event history is cleared. This error condition does not generate any alarm I/O.	Logic Board
57	Dual Charger Error	Flagged when dual charging has exceeded eleven hours; the error code is logged but no further recovery actions take place.	Power Supply Board Battery
58	Audio Control Error	Marks insanity in the audio control software; generates malfunction I/O, which may be followed by a watchdog condition.	Logic Board
59	NOT USED		
60	IPC Silence	Marks silence on the IPC serial link in excess of two seconds, where silence can be broken only by the receipt of well-formed messages containing valid data.	Logic Board Display Board

61	Illegal Error Code	Occurs when error log access/control software is asked to a process an error code it cannot recognize.	Logic Board
62	Power-up Audio Failure	Marks a failure of the feedback circuitry to register at least 0.2VDC during startup audio testing.	Logic Board
63	Illegal ROM Bank Request	Indicates a request to switch to an unknown ROM bank; the error code is logged, then the system is forced into a watchdog condition.	Logic Board
64	NVRAM Battery Failure	Flagged when the NiCad battery is found to be below an acceptable threshold (1) during startup testing, or (2) during run-time testing after a controlled load has been applied.	Logic Board NiCad Battery
65	Software Version Error	Marks a mis-match between Logic and Display software version numbers.	Wrong Display EPROM Wrong Logic EPROM
66-67	NOT USED		
68	TPN Time Error	Occurs on corruption of VersaTaper and AutoTaper time-tracking data.	Logic Board
69-70	NOT USED		
71	Strain Beam Error	Occurs when the main processor does not detect variance greater than or equal to 100 mV between the highest and lowest readings during any 2 revolutions of the pumping mechanism.	Strain Beam Logic Board
72	Motor Revolution Error	Occurs when the actual time required to complete a motor revolution differs from the expected time by ±12% for 3 consecutive revolutions.	Sticking pumping mechanism Logic Board
73	Rate Corruption Error	Flagged when motor control data fails sanity cross-checks.	Logic Board
74	Motor Table Calculation error	Marks a net calculation error in the motor table in excess of 200msec for a single revolution (implying the inability of the processor to perform arithmetic operations correctly).	Logic Board
75	NOT USED		

76	Divide-by-0 Error	Flagged when a divide-by-zero operation is about to occur (the division is by-passed).	Logic Board
77	*Insane Power-Down*	*Occurs when cross-checks preceding* a power-down sequence fail; the error code is logged, then the system is allowed to go into watchdog.	*Logic Board*
78	NOT USED		
79	Insane Key Data	Logged when key data in a Display-to-Logic Processor IPC message has failed an internal consistency check.	Display Board Logic Board
80-89, 90-97	Critical Data Sanity Errors	The following startup and run-time errors arise from NVRAM data insanity: Runtime Powerup Meaning 80 90 VersaTaper Step Inverse Error 81 91 Primary Rate Range Error 82 92 Secondary Rate Range Error 83 93 Primary VTBI Range Error 84 94 Secondary VTBI Range Error 85 95 Total Vol Infused Range Error 86 96 Sec Vol Inf Range Error 87 97 Motor step Range Error 88 NOT USED *89 Fractional Data Range Error*	In the event any of these errors is displayed: check NVRAM battery voltage after charging battery for 8 hours or longer; if still low, replace battery; if within limits, replace Logic Board.
98-99	NOT USED		
100-103	Run-time ROM CRC *Failures*	Marks the failure of the CRC signature *calculated over Logic Processor software to* match that stored in ROM.	Logic Board
104-110	AutoTaper Control and Data Errors	Flagged on AutoTaper control and data insanity.	Logic Board
111-113	NOT USED		
114	Unexpected Startup Key Data	The display processor has sent startup key data during operation	Display Board Logic Board
115-117	IPC Event Tracking	(Not errors)	N/A
118	Unexpected Motor Activity	Occurs when the Display Processor senses motor activity after the Logic Processor has indicated that there should be none, i.e., when the infusion rate has nominally been set to zero.	Logic Board Display Board

119	Rate/VTBI Display Data Error	Occurs when data destined for the rate or VTBI displays is out of range.	Logic Board Display Board
120-123	Illegal Bank-Switched Procedure Call	Flagged on calls to unrecognized procedures during ROM bank switching operations.	Logic Board
124-125	IPC event tracking	(Not errors)	N/A
126-129	ROM Bank Switch Failures	Mark failures of ROM bank switching operations to activate the expected bank.	Logic Board
130	Loss of the Display Processor Half-Millisecond Interrupt	Occurs when the the Display Processor interrupt mechanism is found to be non-functional.	Display Board
131-134	NOT USED		
135	Display Processor Watchdog	Flagged when the Display Processor has deliberately stopped strobing the watchdog circuitry in response to internal error conditions; places the system in watchdog with the error code in the VTBI display.	Display Board
136	Display Processor A/D Error	Marks insanity in the display Processor A/D circuit and/or its reporting mechanism.	Display Board
137	Display Processor Rate Cross-Check Error	Occurs on mis-matches between data reflecting the nominal pumping rate and the rate to be displayed; detected by the Display Processor.	Logic Board Display Board
138	Display Processor Rate Monitoring Error	Marks insanity in the control variable for the state machine on the Display Processor which monitors motor activity.	Logic Board Display Board
139	Display Processor Software Execution Error	Flagged when the Display Processor has sensed a failure in either of its two levels of software processing.	Display Board
140	Display Processor Case Error	Occurs when the Display Processor has found a variable controlling entry to a PL/M 'case' statement to be outside its legal range.	Display Board
141	LED Segment Error	Marks a failure of the run-time 7-segment LED test.	Display Board
142	Watchdog Test Failure	Logged when the Display Processor senses a failure in the startup watchdog test.	Display Board Logic Board

143	IPC Sequence Number Error	Logged when the Display Processor has sensed a failure of the IPC message sequence numbers to be incrementing as they should, indicating a train of lost or badly-formed messages.	Display Board Logic Board
144	Run-time Display Processor ROM CRC Error	Marks the failure of the CRC signature calculated over Display Processor software to match that stored in ROM.	Display Board
145-146	Motor Revolution Error (***Version 8.12 only***)	Flagged when the Display Processor has determined that the motor revolution time is inappropriate for the infusion rate currently in effect.	Display Board Logic Board
147	Missing or Slow Steps	Logged when the Display Processor has detected too little stepping activity for the motor speed reported by the Logic Processor.	Logic Board Display Board
148	Air-In-Line Error	Marks detection of an air-in-line condition by the Display Processor.	Logic Board Display Board
149	Overinfusion Error	Logged when the Display Processor has detected an infusion to have continued at least 3 revolutions beyond the total number of steps indicated by the VTBI which was specified when the infusion was begun.	Logic Board Display Board
150-154	Recoverable IPC Errors	Flagged upon the receipt of illegal or insane data by the Display Processor over the IPC link (non-fatal, covered by redundancy built into the IPC protocol). 150 Display Proc. IPC Rate Data Error 151 Display Proc. IPC Motor Speed Error 152 Display Proc. IPC VTBI Data Error 153 Display Proc. IPC New VTBI Data Error 154 Display Proc. IPC Step Data Error	Logic Board Display Board
155-157	IPC Event Tracking	(Not errors)	N/A
158	(Recoverable) Display Processor IPC message CRC Error	Marks the receipt of illegal or insane data by the Display Processor over the IPC (non-fatal, covered by redundancy built into the IPC protocol)	N/A
159-160	IPC Event Tracking	(Not errors)	N/A

"low battery 2" since the last time this minimum was reset (the maximum displayable value is 9999). In the case where "low battery 2" has never been reached, "- - - -" appears in the VTBI display.

AUDIO TEST

1. Press COMPUTER CONTROL/MONITOR repeatedly until:
   - "Audio Test" scrolls on the Operator Information display.
2. Press START and check:
   - "no audio", "key", "variable", and "max" appear in the Operator Information display.
   - associated feedback voltages appear in the VTBI display.
   - an audible tone is sounded that increases in intensity as each message appears in the Operator Information display.

POWERDOWN TEST

1. Press COMPUTER CONTROL/ MONITOR repeatedly until:
   - "Powerdown Test" scrolls on the Operator Information display.
2. Press START and check:
   - "OFF n" displays statically on the Operator Information display ('n' counts down in seconds from 3 to 1)
   - After reaching 1 the instrument shuts down.

MECHANISM ALARM CIRCUIT (M.A.C.)

Gemini PC-1 instruments are being manufactured with a pump mechanism alarm circuit (M.A.C.) to enhance detection of impact damage to the instrument as the result of dropping or other abnormal handling.

If a PC-1 pump/controller goes into an alarm condition and scrolls "HELP INTERNAL ERROR" following Power On, check the Error Code on the Central Display. These alarm conditions are associated with either faulty AIL hardware or a disconnect in the pump mechanism alarm circuit. To determine the specific problem, perform the following troubleshooting procedures.

a. Turn off the instrument and remove the AC power cord from the AC outlet.

b. Separate the case (refer to Section 5.5.1).
   - Use a 5/32" Allen driver or wrench to remove the four socket head screws that connect the front and rear case assemblies. (Do not leave screws on work surface. Front panel could be damaged if front case is laid on the screws).

NOTE

When separating and positioning the front and rear cases for M.A.C. installation, ensure that no tension is applied to the harnesses connecting the case assemblies.

c. Inspect the upper and lower M.A.C. assembly contacts on each pump mechanism for a disconnected condition.

d. If the M.A.C. contacts (spring clips) are in place, inspect the M.A.C. wires and connectors for a cut or break.

e. If the M.A.C. circuit is intact, then the alarm condition can be attributed to an AIL hardware problem. Follow maintenance manual procedures for troubleshooting, removal and replacement of the AIL/SCD assembly.

f. If the M.A.C. contacts are disconnected, the instrument has been subjected to an abnormal impact condition. Visually inspect the pump mechanism(s) for severe cracks or breaks in the areas around the mounting flanges and housing pivot points. Small cracks do not affect functionality.

g. If no visual damage is detected, attempt to move the top of the pump mechanism laterally (side to side). If the mechanism is intact, there will be very little, if any, lateral motion. If the mechanism is broken, the lateral movement will be easily discernible.

NOTE

Do not mistake movement of the top of the pump mechanism along the hinge axis as

	COMPUTER CONTROL/ MONITOR switch failure	Replace Keypad
Model/Version fails to scroll	Digital Logic Failure Display Board Failure Power Supply Board Failure	Replace Digital Logic Board Replace Display Board Replace Power Supply Board
Model/Version display corrupted	Digital Logic Failure	Replace Digital Logic Board
	Display Board Failure	Replace Display Board
LAMP TEST w/AUDIO		
LED segment fails to illuminate	Display Board Failure Digital Logic Failure	Replace Display Board Replace Digital Logic Board
No Audio adjust	Audio Control Pot. Failure	Replace Audio Control Pot.
KEYPAD TEST		
Key/Display Mismatch or Invalid Key	Keypad Failure	Replace Keypad Assembly
	Display Board Failure	Replace Display Board
ERROR LOG DISPLAY	(See Table 5-2, 2a or 2b for a listing and description of Error Log Codes)	
MOTOR HOMING TEST		
Motor Fails to Home to selected position ±1 step	Motor Harness Disconnected	Reconnect Motor Harness
	Digital Logic Failure	Replace Digital Logic Board
	Motion Sensor Harness Disconnected	Reconnect Motion Sensor Harness
	Motion Sensor Failure	Replace Motion Sensor
PUMP TEST (Allows pumping mechanism to be operated without Alarm stoppage)		
SERIAL PORT TEST		
"echo" test fail	Faulty Communication Plug	Replace Comm Emulator Plug
	Digital Logic Board Failure	Replace Digital Logic Board
	Power Supply Board Failure	Replace Power Supply Board
A/D VOLTAGE DISPLAY		
"strain" reading >'0', set not installed	Strain Beam Out of Calibration	Recalibrate Strain Beam (see Section 5.7)
	Strain Beam Failure	Replace Strain Beam
	Digital Logic Board Failure	Replace Digital Logic Board

	Digital Logic Board Failure	Replace Digital Logic Board
110V only (except V8.12). ECD Sensor - wrong digit for condition	Light Emitter/Receiver Failure	Replace ECD
	Communication Cable Failure	Reconnect or Replace Communication Cable
	Power Supply Board Failure	Replace Power Supply Board
	Digital Logic Board Failure	Replace Digital Logic Board
SCD Sensor - wrong digit for condition	Light Emitter/Receiver Failure	Replace AIL/SCD Assembly
		Analog Circuit Failure Replace AIL/SCD PC Board
	Digital Logic Failure	Replace Digital Logic Board
Motion Sensor - wrong digit for condition	Sensor Failure	Replace Sensor
	Digital Logic Board Failure	Replace Digital Logic Board
Door Sensor - wrong Digit for condition	Sensor Failure	Replace Sensor
	Digital Logic Board Failure	Replace Digital Logic Board
	NOTE **In the 'Selftest' mode, the microprocessor is strobing the sensors in accordance with a software protocol. The digital presentation seen in the RATE and VTBI displays reflects the sensor response to the strobe. If the response is not the expected response, a problem exists within the strobe circuitry.**	
RAM Display	For IMED Engineering use only	
POWER DOWN TEST		
Displays remain On	Digital Logic Board Failure	Replace Digital Logic Board